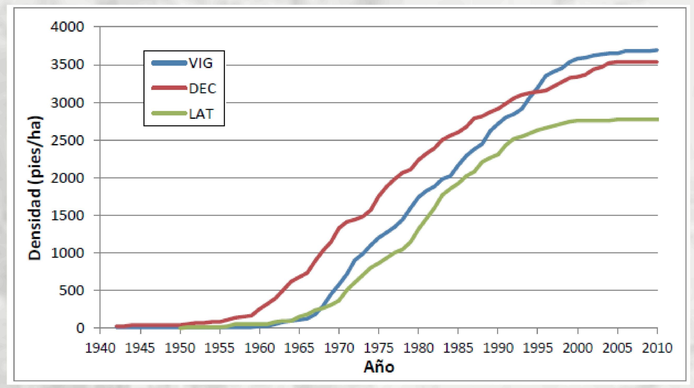
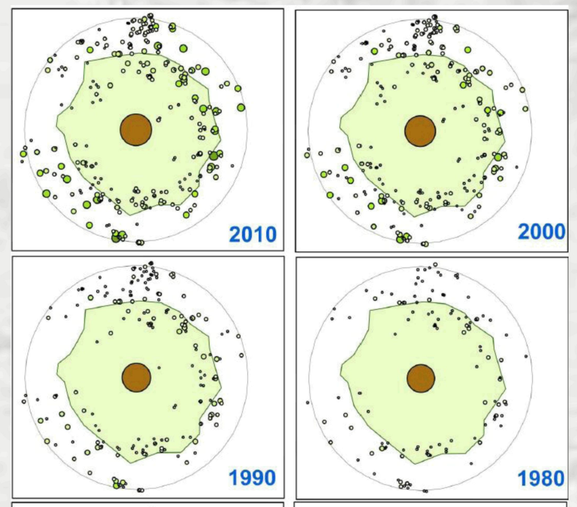
Can we favour growth of multi-centennial beech trees by reducing competition of their offspring?

Jesús Rodríguez-Calcerrada, Guillermo G. Gordaliza, Eva Miranda, Ramón Perea, Inés González Doncel, Luis Gil

Grupo de Investigación en Genética y Fisiología Forestal, ETSI Montes, Universidad Politécnica de Madrid. Ciudad Universitaria s/n, 28040 Madrid (España)

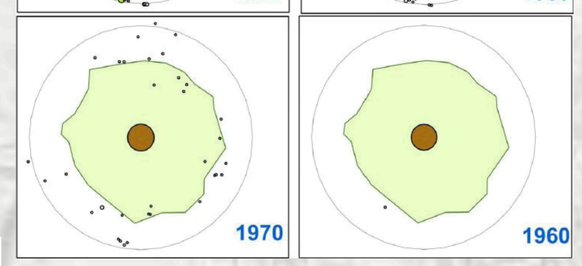
Introduction: Old trees play an important role in forest dynamics and biodiversity; forestry practices can help to improve their conservation. In the "El Hayedo de Montejo" forest (Madrid, Spain), more than **900 multi-centennial beech (*Fagus sylvatica* L.) trees** form the southernmost population of the species, and are one of the main attractions to ecotourism. However, in the last years, these trees are experiencing a dramatic decline, probably because of the interaction of old-age, competition and rainfall reduction.



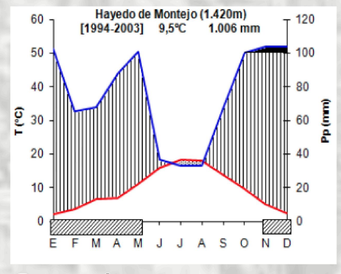


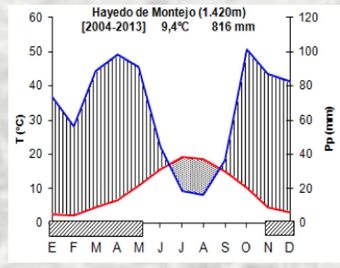
The cessation of cattle grazing in the 1960s fueled beech recruitment and **competition** around old mother trees (*above and right*).

The decrease in rainfall over the last 10 years has enhanced **summer drought** intensity (*below*).

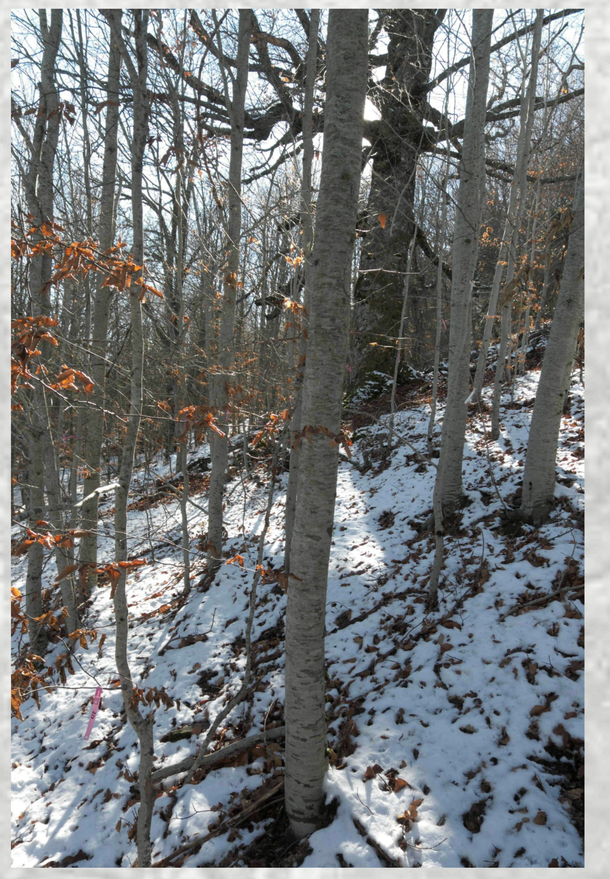


(above) Multi-decadal recruitment around an ancient beech tree after grazing was banned in the 1960s. Most trees recruited in the edge of the old tree crown (delineated by the green area), likely due to light-mediated competitive exclusion beneath the crown. Tree age was estimated by the number of growth rings at the stem base.





Methods: The basal area of all individual trees recruited within a distance of 15 m from an old beech tree was summed up and referred to the hectare in 15 plots with different size of regeneration (*below*).



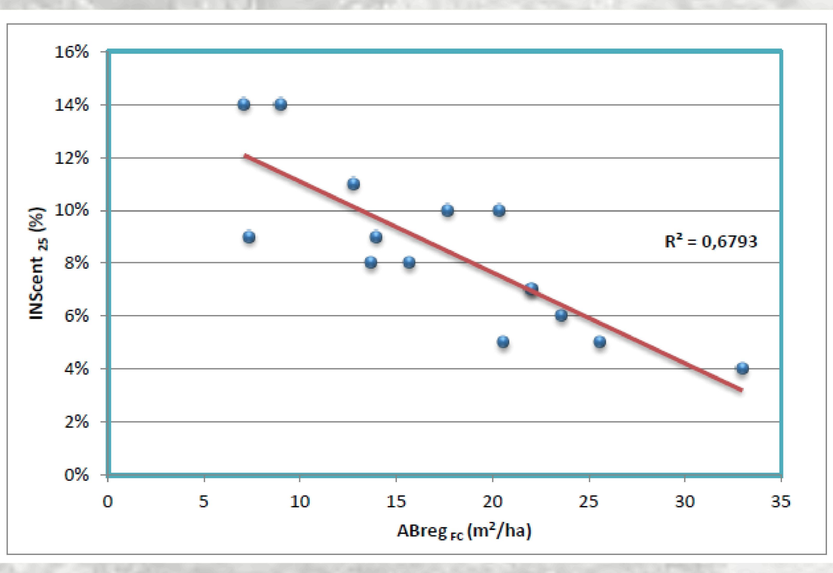
Thereafter, 60% of basal area of recruits growing around three **vigorous** and three **weakened** old beech trees was removed (*below*)

Questions:

1. How does the extent of regeneration affect the growth of old trees?
2. How does reduction of density through thinning affect the growth of residual **young and old** trees?

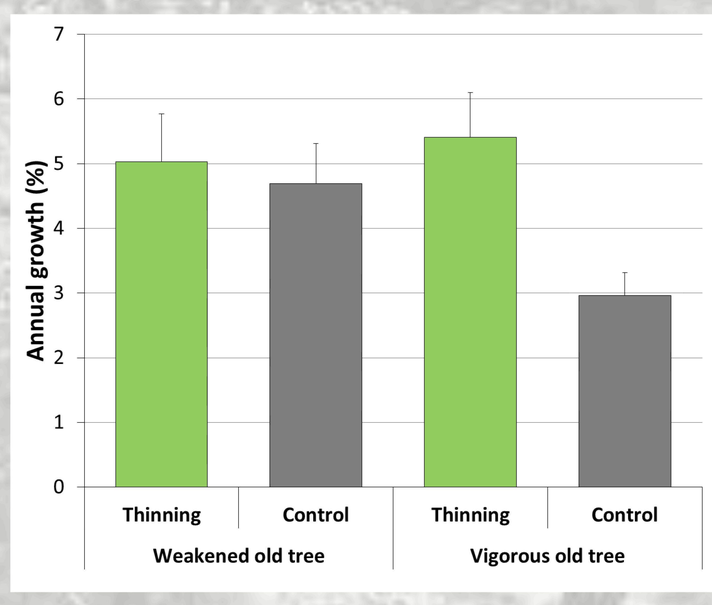
Results:

Question 1. The radial growth of old trees is negatively affected by the size of the offspring (*below*).



(left) As basal area of recruited trees increases from 5 to 30 m^2 ha^{-1}, basal area increment (percentage) of ancient trees declines from 12 to 4% (in the last 25 years).

Question 2.1 Thinning has a positive effect on the radial growth of residual young trees (measured with dendrometer bands), but only in the plots centered around vigorous old beech trees.



(left) On average, recruits around vigorous old beech trees duplicated in diameter over the first year of thinning.

The most likely explanation is that old vigorous trees are strong competitors and dominate young recruits, which benefit when resources increase after thinning. On the contrary, old weakened trees barely compete for resources with young recruits, which grow fast even in unthinned plots.

Question 2.2 The effect of thinning on radial growth of old beech trees has not been assessed yet, to let more years to pass before sampling the stem with a (potentially damaging) **increment borer**.